The Healthcare Executives Role in Technology Decisions: Surgical Simulation to Reduce Training Time, Increase Case Access, Increase Expertise, and Reduce Errors

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Panelists

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Simulation and Surgical Education

INTRODUCTION

Tim Liezert, FACHE
Simulation in Surgical Education:
Innovation to reduce training time, increase case access, increase expertise, and reduce errors

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Approved for Public Release.
Errors Eliminate Profits

• Minor Complication
  – Revisit eliminates all profit from the original surgery

• Major Complication
  – Revisit costs 3X the profit from the original surgery
Creating Experts & Eliminating Errors

10,000 hours to become an expert - Gladwell

“There is no excuse for the surgeon to learn on the patient.” – William Mayo, 1927
Medical Education – Explosion of Information

• Medical procedures are becoming more numerous and more complex – medical knowledge has “hypertrophied” (Cooke, 2006)

• Training residents to a common level of knowledge and competence is already impossible (Satava, 2008)
“The Perfect Storm” (Murphy, 2007)

- Risk to patient health. (McDougall, 2007)
- Ethics of practicing on patients. (Satava, 2004; Murphy, 2007)
- Cost is a barrier to training. (Bridges, 1999)
- Insurance coverage of educational actions. (Satava, 2004)
- Working hour limits. (Satava, 2004)
- Availability of training opportunities. (Birden, 2007; Davis, 1999)
- Access to training. (Dunkin, 2007; Spitzer, 1997)
- Complexity of modern surgery. (McDougall, 2007)
- Volume of unique procedures. (Reznick & MacRae, 2006)
- Proficiency-based Medicine. (Murray, 2005)
- Quality of technology. (Murphy, 2007)
- Expectations around computer technologies. (Murphy, 2007)
- Acceptance of technology. (Ziv, 2003)
- Learning from Mistakes. (Ziv, 2005)
Objectives for Simulation in Education

- Objective 1: Reduce Cost
- Objective 2: Increase Case Access
- Objective 3: Reduce Training Time
- Objective 4: Reduce Errors

Similar Motivations in Military, Industrial, and Medical Training
Objective 1: Reduced Cost

- Surgery as a teaching event consumes resources that could generate additional revenue. (Bridges & Diamond 1999)
  - 186 hours over a 4 year residency
  - Estimate OR costs at $257.40 per hour.
  - Adds $47,970 to the cost of a medical education.

- Updated: Adds $186,363 to $279,545 during four year residency
  - US OR is $1,500 per hour (Frost & Sullivan, 2004)
  - Swedish OR is $1,000 per hour (Hyltander, 2003)
Objective 2: Increased Access

• Good laparoscopic skills cannot be developed by merely watching an expert. Laparoscopic proficiency is only realized after sufficient practice in the minimally invasive environment.” (Pearson et al, 2002)

• Students trained in VR are 29% faster at performing laparoscopic surgeries and make up to five times fewer mistakes (Enochsson et al, 2004; and Seymour, 2002)

• Learning begins with “do one” (Jordan et al, 2001; Gallagher et al, 2001b; Madan & Frantzides, 2007).
Objective 3: Reduced Time

- Lap simulators differentiate experienced from inexperienced users based on their performance scores with the simulator (Adamsen et al, 2005)
- MIST-VR simulator could determine which students will never achieve proficiency and should be dropped from a training program (Gallagher et al, 2004)
- Non-VR trained students are nine times more likely to fail to make progress in their performance than those who use VR in their training (Seymour, 2002)
Objective 4: Reduced Errors

• Medical error is responsible for between 44,000 and 98,000 deaths per year (IOM, 1999).

• Laparoscopic surgery has an error rate that is three times higher than that of open surgery. Error rate has not been decreasing over an eight year period as surgeons become more experienced (Huang et al, 2005).

• In laparoscopy, observation does little to convey the skills that must be mastered. Only actual practice has been effective at this (Jordan et al, 2001; Gallagher et al, 2001b; Madan & Frantzides, 2007).

• Simulations can improve the performance of surgeons because they become familiar with the appearance of organs and tissue on a two dimensional computer monitor (Huang et al, 2005).
• Assumption 1: Didactic Education is Effective
  – Though surgeons or residents may learn new information during educational lectures, they do not incorporate it into their practice. It has no impact on their actions in delivering medicine. (Davis et al 1995 & 1999; Weller et al 2005)

• Assumption 2: Sufficient Access to Faculty and Patients is Possible
  – Availability of faculty is a major limitation in medical education (Dunkin et al, 2007; Satava, 2008)
  – Many studies assume adequate access a priori (Gerson & Van Dam, 2003)

• Assumption 3: Practicing on Live Patients is Acceptable
  – Medical schools, faculty, and residents are finding new restrictions on the type and amount of training that can be conducted with a live patient (Murphy et al, 2007; Murray et al, 2005; Satava, 2004a; Ziv et al, 2005).
Training Technology Options

Human

Animal

Box Trainer

Part Task

Mannequin

VR/Game Tech
<table>
<thead>
<tr>
<th>Human</th>
<th>Animal</th>
<th>Box Trainer</th>
<th>Mannequin</th>
<th>Simulation</th>
<th>VR/Game</th>
</tr>
</thead>
<tbody>
<tr>
<td>Learn on humans:</td>
<td>Learn on animals:</td>
<td>Learn on organs in a box:</td>
<td>Learn on a physical replica:</td>
<td>Learn on an animated machine:</td>
<td>Learn on computer images:</td>
</tr>
<tr>
<td>Living patients, the newly dead, and cadavers</td>
<td>Living and newly dead pigs, cats, and others</td>
<td>Human-shaped box contains organs, tissue, or test devices</td>
<td>A full-body device with synthetic skin, organs, and fluids</td>
<td>Includes computer, hydraulics, pneumatics, and electrical responses</td>
<td>Mathematical models, visual images, sounds, and some tactile feedback</td>
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### Advantage

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</thead>
<tbody>
<tr>
<td>Exact Replica, Existing OR</td>
<td>Similarities, Availability</td>
<td>Availability, Convenience, Human Shape</td>
<td>Human Shape, Logistics</td>
<td>Rich Experience, Multi-Function, Programmable</td>
<td>Rich Experience, Flexibility, Low Cost</td>
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### Disadvantage

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</thead>
<tbody>
<tr>
<td>Scarcity, Single Use, Ethical Issues</td>
<td>Anatomy, Single Use, Social Mores</td>
<td>Not Alive, Single Use, Animal Organs</td>
<td>Static, Lacks Realism</td>
<td>High Cost, Complexity</td>
<td>Screen-barrier, Non-tactile</td>
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### Examples

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</tr>
</thead>
<tbody>
<tr>
<td>Cadavers</td>
<td>Porcine Labs</td>
<td>MIC-Trainer</td>
<td>CPR Annie</td>
<td>Sim One</td>
<td>MIST-VR dV-Trainer</td>
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Game Technology in Medical Education. Roger Smith, 2009. [Available at Amazon.com]
References (1)

References (2)


References (3)


Q & A